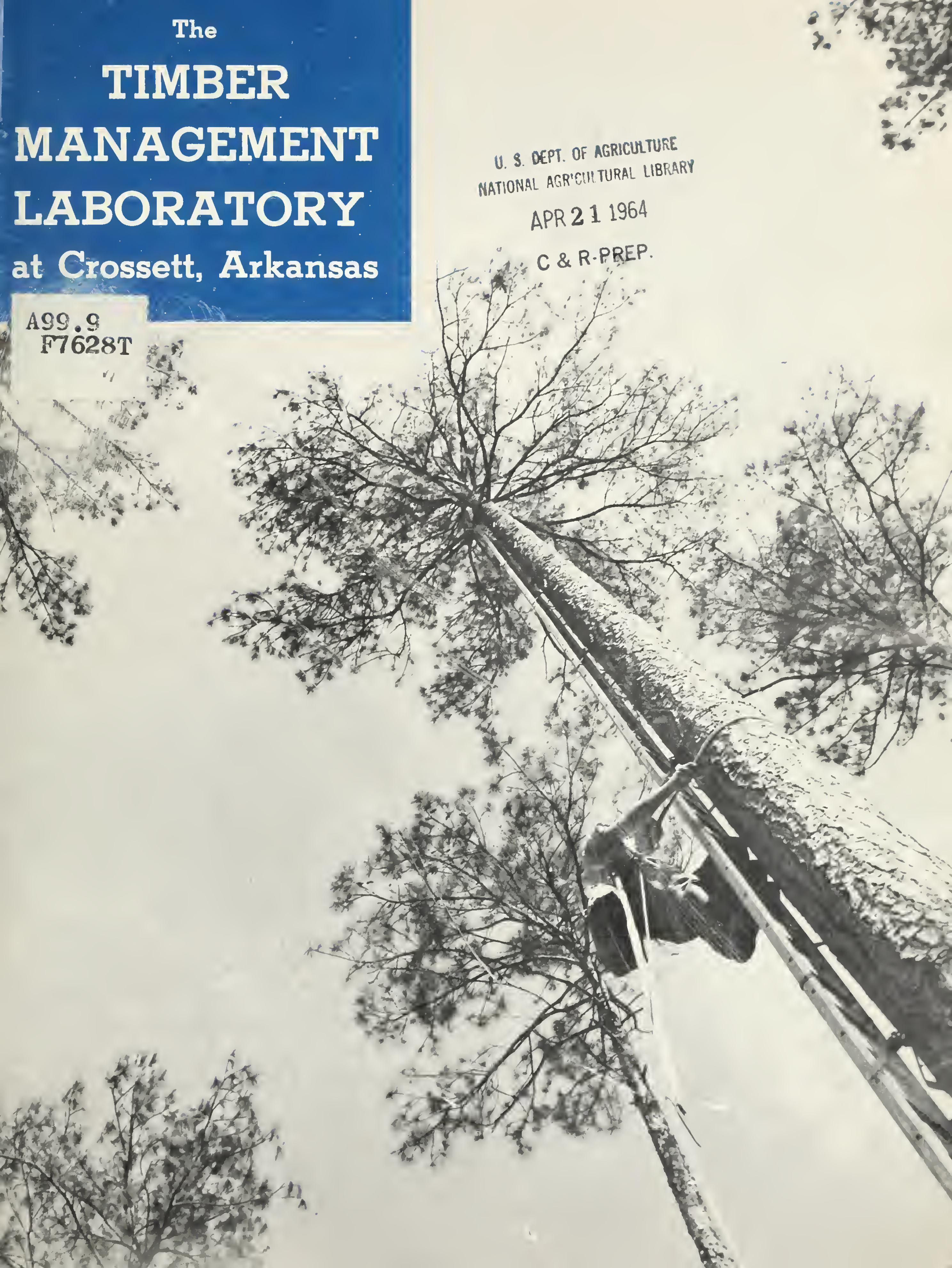
The

TIMBER MANAGEMENT LABORATORY

at Crossett, Arkansas



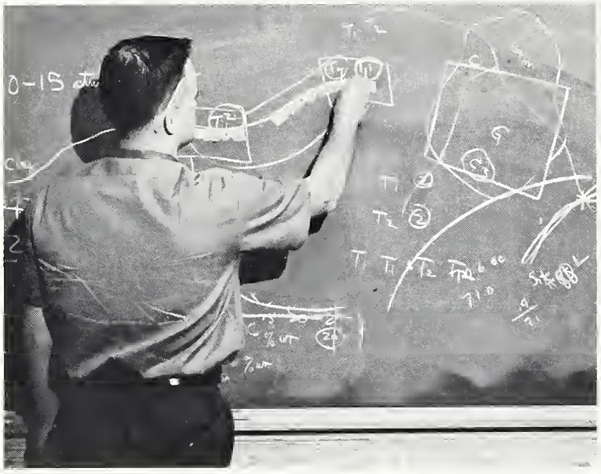
Welcome to Crossett

Plan to stay a while. There's much to see.

You probably came to learn about the management of upland forests of loblolly and shortleaf pine. We think you won't be disappointed. Here, at the first research center established in the Midsouth by the Southern Forest Experiment Station, you are able to see results of research begun more than 25 years ago.

You may have hopes of adapting some of the procedures you will see here to your own particular situation. This may be possible, for many principles of forest management developed at Crossett apply throughout the loblolly-shortleaf range in the Midsouth—31 million acres in five southern States.

the 'HOW' and the 'WHY'



The Crossett research unit of the U. S. Forest Service is part of a three-platoon team: forest landowner, forest industry, and forest research. As a team, we have aided the development of a vast area's economy. Together, we have learned how to grow more timber in the upland loblolly-shortleaf belt.

As part of this team, the Crossett center has the job of providing management guidelines for landowners; and of helping to find how the forests should be managed for bumper timber crops. These studies are continuing, but we are steadily shifting emphasis to a more basic type of research—from "how" to "why."

Until we learn *why* differences in tree growth come about, our ability to further increase the amount and quality of timber will be greatly limited. So we're supplementing our scaling sticks with microscopes at Crossett. We want to probe beneath the bark and under the forest floor to find out more of the tree's inner secrets. When we understand *why* the tree grows as it does, we will know more about *how* and *when* to manage *what* species *where*.

WHEN we started

By the mid-1930's the ten million acres of loblolly-shortleaf pinelands in north Louisiana and south Arkansas were producing only a tiny fraction of their timber potential. The virgin timber had been cut, and few landowners were planning for a second crop.

Here, as elsewhere throughout the South, saw-log trees were few, and much of the pine land was occupied by low-value hardwoods. The chances for another large pine timber crop appeared bleak.

When the Crossett Research Center was established in 1934 it had one big assignment: Help find a way to put a forest back together again.

That was quite a challenge, but there were many factors working in favor of the forester. Rainfall was ample—52 inches of it annually. There was a long growing season—218 days in the average year. Also, many small pines had somehow survived the cutting of the virgin timber and the fires that followed, and had grown and produced seed. Pine seedlings were often abundant under the low-quality hardwoods—just waiting to leap into height growth if someone cleared the way.

Much of the good loblolly-shortleaf land was overgrown with undesirable hardwoods in 1930.

A TYPICAL STAND, before removal of low-quality hardwoods (1944).

SIXTEEN YEARS AFTER low-quality hardwoods were removed.

UNLEASHING THE PINES

Many of Crossett's early studies were devoted to the removal of cull hardwood and its effect on pine growth. They proved that an investment in release of seedlings will pay a landowner handsome dividends. For example, stands in which hardwoods above two inches in diameter were killed in 1939 were quickly ready for pine thinnings that sold for **four times** the cost of treatment. Today, with chemical treatments that kill hardwoods with a minimum of sprouting, we could push wood yields even higher.

Seedling (left of sign) was released from overstory hardwood competition.

The same seedling 20 years later (tree at right).

HARDWOOD UNDERSTORY robs pine stands of soil moisture that is especially needed during dry seasons.

Researchers are eyeing *understory* hardwoods, too. How much moisture do they sap from the ground? Are they hindering pine growth? A study was begun in 1951 to compare pine growth on plots carrying a normal understory of hardwoods with growth where all understory hardwoods were deadened with chemicals.

During wet years, pines grew as well on plots with a hardwood understory as they did on plots that were freed of hardwoods. But during dry years, pines on plots with no hardwood understory added almost twice as much diameter growth as those on untreated plots.

Many methods of cull hardwood removal have been tested for upland sites. Foliar sprays, single-stem treatments, controlled burning—all are effective. But no one method suits all conditions; sometimes treatments must be combined or repeated.

Such research deals with the *adverse* effect of upland hardwoods. How about their good points? If hardwoods are eliminated from stands, or if the stands are burned at regular intervals, will many of the beneficial soil organisms disappear? If so, will the soil pack and lose some of its ability to absorb and store water? Will the plant nutrients returned to the soil each year by leaf litter be lost? Will these situations in turn reduce the site quality? A long-range study now in progress may reveal the answers.

REMOVAL OF UNDERSTORY increases pine growth during dry seasons.

THE FARM FORTIES

Forty percent of the forest land in the south Arkansas-north Louisiana area is in tracts of less than 500 acres. Can the owner of a small tract afford forest management? If so, how much money can he expect to make from a 40-acre tract? Crossett researchers set out to find the answer by establishing two "show me" plots in 1937—one with a good stand of timber and another with a mediocre stand. Knowing that a farmer would need some income every year, something was sold off the tracts each year while improving the pine growing stock in both stands.

The "poor" forty yielded $6,434 in stumpage the first 25 years. Although stumpage worth an average of $257 was cut each year, the tract now has more than twice as much sawtimber on it as before.

GOOD FORTY: 1962.

The "good" forty, established to show the farmer what returns he might expect once his tract was in good condition, has yielded an average $432 stumpage per year. It, too, has more and better growing stock than at the start of the demonstration.

ONE YEAR'S HARVEST from the good forty demonstrotes to visitors thot good forest monogement on smoll woodlonds con be profitoble. These products—obout equol to o yeor's growth on the troct—hod on on-the-stump volue of $832.

POOR FORTY can no longer be considered "poor" after 25 years of forest management. More timber has been cut from it than was present when the study started, yet the amount and quality of the pine growing stock exceeds that of the original stand.

MANAGEMENT STUDIES

PINE REPRODUCTION soon appears in forest openings of the Crossett area.

In all-aged management, wood products ranging from fence posts through saw logs are produced continuously on every tract. A 958-acre study was set up to find out:

Costs and returns from this system of management;

The best cutting cycle; and

What reproduction problems would be encountered.

After 20 years, the pine saw-log growing stock had doubled on most plots, although as much saw-log volume had been cut as was present when the study started. Pine reproduction posed no problem.

Conclusion: **With normal weather and desirable stocking, these pinelands should grow 500 board feet per acre per year under all-aged management. That would be two to three times the average on an unmanaged acre.**

Cutting cycles of 3, 6, and 9 years are being tested for their effect on costs, returns, and yields under this type of management. All indications are that the shortest possible cutting cycle will yield the greatest amount of forest products per acre per year.

ALL-AGED STANDS yielded the most timber when cutting cycle was short (three years).

Studies at Crossett will compare large-product and small-product profits under different types of management.

Advantages of Various Management Systems

Early in the history of Crossett, a long-term study of three major management systems was established:

1. Even-aged management, whereby all trees are cut except those needed for seed;
2. All-aged management, whereby plots were left intact and individual trees are selected for harvest; and
3. Diameter-limit cutting, in which trees above a 12-inch diameter are harvested at 10-year intervals.

It is too soon to estimate what the long-term growth rates under each system will be, but pine reproduction under the three systems has been excellent. Within 10 to 15 years after the first cut, the plots had the following numbers of seedlings or saplings per acre:

Even-aged	3,800
All-aged	2,900
Diameter-limit	3,200

Large and Small Products

Many landowners want to specialize. Some would like a maximum amount of *small* products from their land—fence posts, pulpwood, and small saw logs. Others need all the *large* products they can grow, such as saw logs, poles, and piling. What volume of each type is possible when management is directed toward such specialized goals? A 900-acre study was begun in 1948 to provide guidelines on (1) logging and production costs and (2) timber volumes and values on:

30-year-rotation plots for *small* products
60-year-rotation plots for *large* products.

So that results may be widely applicable, both even-aged and all-aged management systems are represented.

Even-aged stands now cover thousands of acres once devoted to farmlands. The landowner needs to know the most productive and profitable degree of stocking.

How much stocking is needed in all-aged stands?

How Much Stocking to Carry?

As landowners in the loblolly-shortleaf zone began to perceive how rapidly natural and artificial regeneration produced young forests, they wanted scientific advice on management. What amount of growing stock is best for even-aged stands, on both good and medium sites? Should early thinnings be generally from above (larger trees cut) or from below (larger trees saved)? To find out, in 1949 we established 27 plots on good sites and 27 plots on medium sites. At five-year intervals, stands have been thinned back to the following basal areas (total cross-sectional areas, at 4½ feet above ground, of all the trees in the stand):

70 square feet per acre
85 " " " "
100 " " " "
70 " " " "
at beginning, increasing
to 100 from age 20 to 55.

In the early thinnings, half the plots were thinned from below and half from above. So far, no one thinning method has produced a significant advantage in volume growth over any other one.

Going for the Jackpot!

Since poles and piling are worth two to five times as much as saw logs for the same volume, why not go for the prize money? Can it be done? If so, what growing stock is needed for maximum pole production and what are the chances of making more money than by managing for saw logs and pulpwood alone? On test plots, we are thinning every five years to basal areas of:

55 square feet per acre
70 " " " "
85 " " " "
100 " " " "
115 " " " "
130 " " " "

Pole production offers bonuses to the tree farmer. Can stands be managed to produce more poles per acre?

IMPROVING THE TREE'S DIET

When a stand is thinned, the growth of remaining trees is accelerated. Is this mostly because each tree left suddenly has more water and soil nutrients available to it? To learn more about the reason for this growth speed-up, we planted one-year-old loblolly seedlings on several plots. We are irrigating some plots, fertilizing some, and doing both on others. The results after the first eight growing seasons:

	Height in feet	Diameter in inches
Watered	36.6	6.4
Fertilized	34.4	7.0
Watered and fertilized	36.7	7.3
Control plot	30.8	5.6

Tentative conclusions: Height growth is stimulated by irrigation.
Diameter growth is stimulated by irrigation and fertilization—fertilizer having the greatest single effect.

No fertilizer was given this tree. Natural rainfall watered both it and the one at right.

Fertilizer was added to this tree's diet. Both trees are the same age and on adjacent plots.

The fertilized plots produced pulpwood-size trees in six years after seedlings were planted, but the added growth hasn't yet repaid the cost of fertilizing.

Guyed trees so far have developed less-dense wood but a more cylindrical stem than those allowed to sway.

DO TREES GROW STRONGER WITH EXERCISE?

Trees not only grow faster after the stand is thinned, but they grow differently. Could the increased sway in the opened stands be responsible? In other words, do trees grow sturdier with exercise? Apparently yes. Crossett foresters guyed several trees, limiting their sway in the breeze. These trees developed trunks that were more cylindrical (with less taper) than those of swaying trees. Therefore, it appears that much of the extra growth of trees in a thinned stand goes onto the lower stem to buttress the tree against wind movement.

PINE ROOT GROWTH

After a stand is thinned, how fast do the roots of the remaining trees take over the space that has been opened up to them? In a 15-year-old stand, we reduced the number of trees from 1,000 to 100 per acre, then clocked the root growth. Within five years, new roots had occupied the entire area down to a depth of 24 inches.

SUDDEN SAW LOGS

To test a tree's ability to utilize soil nutrients and moisture, we thinned a 9-year-old stand to 100 trees per acre. We left a check plot with 712 trees per acre. The purpose: to see how quickly saw logs can be grown when there is little competition. The possibilities are fascinating. If an area's growth potential could be channeled to fewer trees:

Management costs per 1,000 board feet of saw logs would be lower;

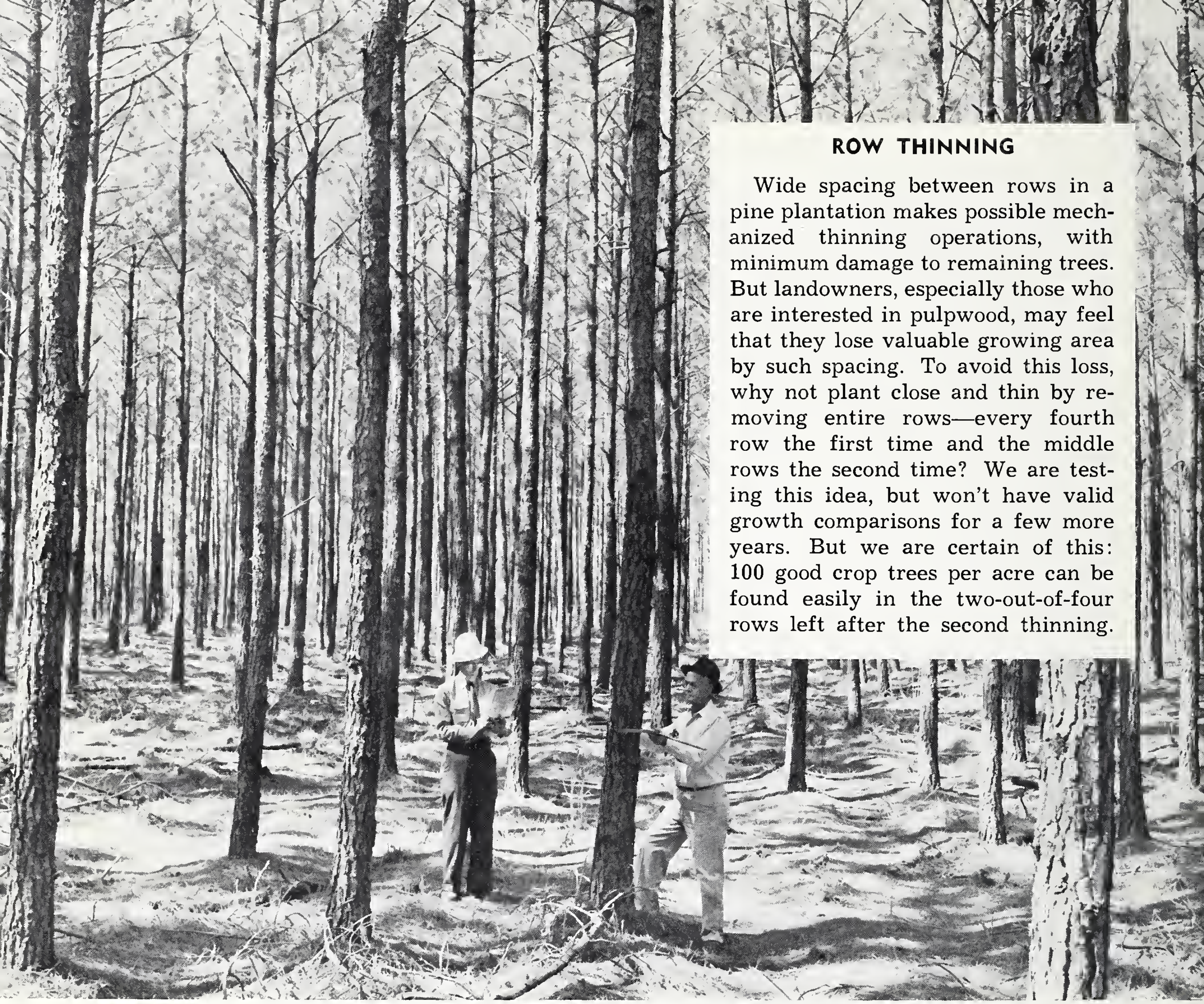
Saw logs could be harvested sooner; and

Fire losses would be lower, because fast-growing trees have thicker, more resistant bark.

Results so far are encouraging. During the first eight years, the diameter growth of the widely spaced trees was 50 percent more than that of the check plot trees.

Normal stand used as check plot.

Sudden-saw-log stand has only 100 trees per acre.



ROW THINNING

Wide spacing between rows in a pine plantation makes possible mechanized thinning operations, with minimum damage to remaining trees. But landowners, especially those who are interested in pulpwood, may feel that they lose valuable growing area by such spacing. To avoid this loss, why not plant close and thin by removing entire rows—every fourth row the first time and the middle rows the second time? We are testing this idea, but won't have valid growth comparisons for a few more years. But we are certain of this: 100 good crop trees per acre can be found easily in the two-out-of-four rows left after the second thinning.

THE CASE OF THE MISSING SEEDLINGS

Only one out of 100 pine seeds in a seedfall lives to become a one-year-old seedling. Here at Crossett, we are trying to improve these odds. We are evaluating the effect of too much water, too little water, fungi, birds, rabbits, other rodents, and various site factors, including condition of the soil surface. Too, we are studying the relationship between crown development and cone production, and looking for ways to increase cone production.

PROBING THE FOREST UNDERGROUND

Importance of Site

Some sites are capable of growing much more timber per acre than others; but what are the best sites for loblolly and shortleaf pine? Crossett studies have provided reliable methods of estimating site quality by measuring (1) surface soil thickness, (2) subsoil texture, and (3) slope. Knowing the site's potential to grow trees, landowners can decide on tree spacing and length of rotation.

"Plugging in" for moisture. Temperoture ond moisture of the soil ot different levels ore reloted to growth.

Importance of Soil Moisture

Without exception, growth on soil-moisture study plots has been greatest during wet years. But trees grow faster on some sites than on others, even with the same amount of moisture. Because soils differ in the tenacity with which they hold water, the amount of water present in the ground doesn't in itself determine how much is available to trees. A clay soil, for example, might hold more water than sand, but might also hold it more tightly—so that less could be taken up by trees. Studies are gauging tree growth on different soils under different moisture levels.

Soil sompler hos become commonploce in Crossett reseorch.

Soil Moisture and Wood Density

Because we are trying to increase the quality as well as quantity of wood, we are beginning to probe into the mysteries of wood density. Trees with dense wood produce the strongest lumber and the most kraft pulp per cord. In early spring trees grow what is known as "springwood." Then, some time later in the year, off clicks springwood and on clicks the more dense and valuable "summerwood." We hope to learn the effects of soil moisture, air temperature, age, and silvicultural treatment on the amounts of springwood and summerwood formed.

Trees ore plonted in borrels so thot the omount of soil moisture con be controlled precisely. This will help determine the effects of moisture on wood density.

A TREE WAS JUST A TREE

Foresters don't accept the fact that "a tree is just another tree." Like people, all trees are different and some of their differences are hereditary.

One of the jobs in tree-improvement research is to find the "plus trees"—those that are taller, straighter, less limby, and have less taper than the millions around them—then plant their progeny to see if the outstanding characteristics are hereditary. Tree-improvement research at Crossett started in 1952 in cooperation with The Crossett Company (now a division of the Georgia-Pacific Corporation). During the first 10 years, out of millions of prospects, 70 outstanding trees have been selected for testing.

Techniques of Propagation

Seedlings obtained from the seed of plus-tree candidates are planted in test areas. Once a tree has proved that it can pass along its good traits to offspring, progenies from the parent—usually in the form of grafted stock—are planted in "seed orchards" to eventually provide larger amounts of superior tree seed.

To speed the testing and multiplying of superior tree stock, another method of propagation will be very useful when it is perfected—the rooting of cuttings. Still another method is air-layering, whereby a branch of the tree is induced to grow roots before it is severed.

Tailor-Made Trees?

Can we fashion trees to our liking through breeding? Agricultural workers have had phenomenal success in improving vegetables, flowers, and field crops by controlled breeding. Through a program of breeding and selection at Crossett, outstanding trees are being crossed in attempts to combine within the offspring the best traits of both parents.

GRAFTING is the best-known method of propagation.

AFTER A BRANCH GROWS ROOTS, it becomes a candidate for the "seed orchard." The new, complete little tree is used in heritability studies.

ROOTING involves cutting off the branch tip and planting it in greenhouse. Rooting is stimulated by hormones.

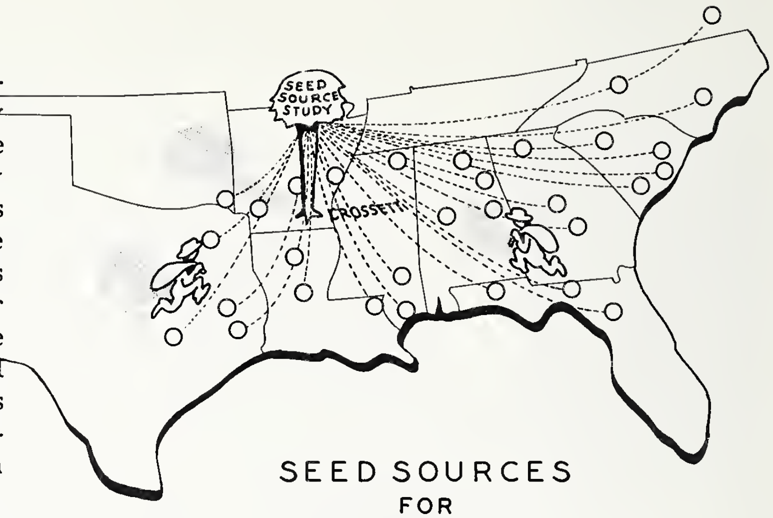
AIR-LAYERING. A branch of the tree is induced to grow roots before it is severed from the tree.

LONGLEAF-SLASH HYBRID seedlings start height growth the first year. These grew nine feet tall in four years.

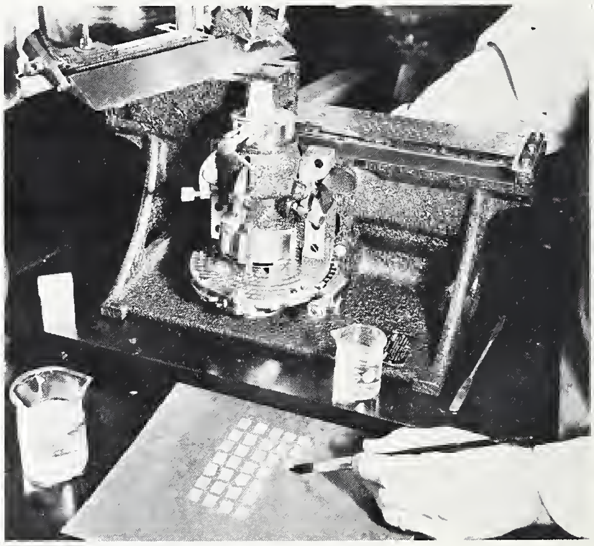
Are Our Native Trees Best?

Loblolly pines from 36 different locations—covering the entire loblolly range from Delaware to Texas—are being compared in a cooperative study at Prescott, Arkansas. The purpose is to determine the effect of seed source on growth. After five years, indications are that seeds from some of the other localities produce trees that are more vigorous than those grown from local seed. A few non-native seed sources apparently yield seedlings with better-than-average resistance to fusiform rust.

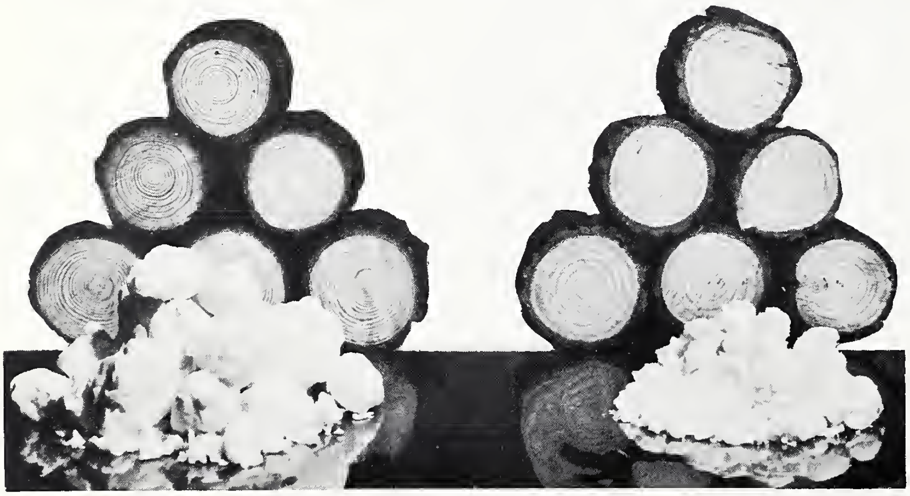
More than 250 non-native seed sources are being studied in the Crossett area. Tree improvement projects here involve more than 157,000 seedlings on 2,500 plots, mostly on lands of private cooperators in south Arkansas and north Louisiana. Other study plots are being maintained by cooperators across the South.



SEED SOURCES FOR TEST PLANTINGS AT CROSSETT



MICROTOME is used to slice wood 3/5,000 of on inch thick for microscopic study.



WHY WOOD DENSITY IS IMPORTANT. Dense wood (left) yields more pulp than less-dense wood.

Little Tree, What Now?

Fascinating subject, the tree. Locked inside its bark cover are enough mysteries to tease man's mind for centuries to come. But forest researchers are probing deeply into these mysteries, and the ensuing years will unfold some exciting discoveries about tree growth. Will our forests be coaxed to produce 2,000 board feet per acre per year in the future? Who can say they won't?

Our work at Crossett will help to fit the pieces together. Specifically, we want to control wood quality through stand management. We will try to find better ways of determining potential growth on a given site. We want the answer to full and immediate regeneration of a new crop after cutting. We want to give more attention to soil factors and tree improvement.

Come back . . . the best is yet to come!

SOUTHERN FOREST EXPERIMENT STATION
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

1963